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H04N 1/387
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(72)Inventor : MORIWAKI YOSHIMI

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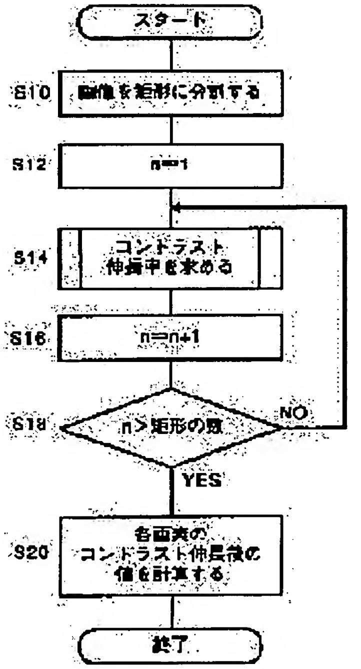
(54) DEVICE AND METHOD FOR IMAGE PROCESSING FOR PERFORMING CONTRAST CORRECTION

(57)Abstract:
PROBLEM TO BE SOLVED: To easily obtain an effect not to emphasize a contrast more than needed at high speed by dividing areas inside a rectangle based on brightness and extending the contrast in every area regarding the rectangle the histogram of which has multi-peaks.
SOLUTION: Contrast correction by a CPU regarding the rectangle the histogram of which has the multi-peaks is performed by dividing an image into rectangles first (S10). A number (n) to represent the rectangle is defined as 1 (S12) and contrast extension rate is calculated for the rectangle. And (n) is increased (S16), when (n) becomes larger than the number of rectangles (S18), this processing is repeated for all the rectangles. Next, each pixel of the image is converted at extension rate of the rectangle in which the pixel is included. A brightness value is calculated at the contrast extension rate of the adjacent rectangles for every rectangle and the brightness value after conversion is calculated by linear interpolation (S19) to keep continuity of brightness with the adjacent rectangle.



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of rejection]
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Bibliography

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(43) [Date of Publication] October 13, Heisei 12 (2000. 10.13)
(54) [Title of the Invention] The image processing system and approach of performing contrast amendment
(51) [The 7th edition of International Patent Classification]

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7/00
H04N 1/387
1/407

[FI]

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G06F 15/70 325
H04N 1/40 101 E

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[Theme code (reference)]

5B057
5C076
5C077

5L096

[F term (reference)]

5B057 CA08 CA12 CA16 CB08 CB12 CB16 CC02 CE03 CE11 DA08 DB02 DB09 DC23
5C076 AA01 AA27 AA36 BA06 CA10
5C077 LL19 PP15 PP21 PP68 PQ19
5L096 AA06 DA01 EA45 FA14 FA37 GA19 MA03

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Epitome

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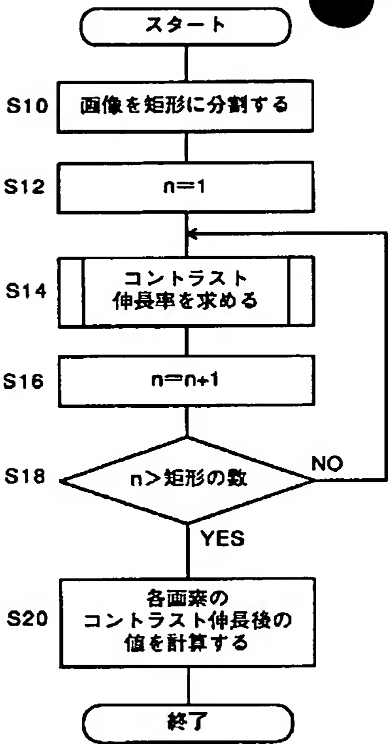
(57) [Abstract]

[Technical problem] The image amendment processing which makes contrast the optimal automatically is offered.
[Means for Solution] An image is divided into two or more rectangles, an image is divided into two or more rectangles in the image processing system which performs contrast expanding for every rectangle, the lightness histogram of each rectangle is created, and it investigates whether a histogram has multiphasic for every rectangle. And about the rectangle in which the histogram has multiphasic, field division of the inside of a rectangle is carried out by lightness, and contrast is elongated for every field. Moreover, while asking for the rate of contrast expanding for every rectangle, the rate of contrast expanding of the rectangle is made small about the rectangle judged that it investigates whether the lightness histogram of each rectangle has multiphasic, and the created histogram has multiphasic.

[Translation done.]



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CLAIMS

[Claim(s)]
[Claim 1] It is an image processing system equipped with a contrast expanding means carries out field division of the inside of a rectangle by lightness, and elongate contrast for every field when the division means which divides an image into two or more rectangles, a histogram creation means to create the lightness histogram of each rectangle, a distinction means to investigate whether the histogram created by the histogram creation means has multiphasic, and a distinction means judge that the histogram has multiphasic.
[Claim 2] The image-processing approach which divides an image into two or more rectangles, creates the lightness histogram of each rectangle, investigates whether a histogram has multiphasic for every rectangle, carries out field division of the inside of a rectangle by lightness about the rectangle in which the histogram has multiphasic, and elongates contrast for every field.
[Claim 3] The record medium which recorded the program for making a computer perform the step which carries out field division of the inside of a rectangle by lightness, and elongates contrast for every field about the step which divides an image into two or more rectangles, the

step which creates the lightness histogram of each rectangle, the step which investigates whether a histogram has multiphasic for every rectangle, and the rectangle in which the histogram has multiphasic and in which computer reading is possible.

[Claim 4] An image processing system equipped with the division means which divides an image into two or more rectangles, a histogram creation means to create the lightness histogram of each rectangle, a distinction means to investigate whether the histogram created by the histogram creation means has multiphasic, a means to ask for the rate of contrast expanding for every rectangle, and the means that makes small the rate of contrast expanding of the rectangle about the rectangle judged that the histogram has multiphasic.

[Claim 5] The image-processing approach which makes small the rate of contrast expanding of the rectangle about the rectangle judged that divide an image into two or more rectangles, investigate whether the histogram which created and created the lightness histogram of each rectangle has multiphasic, ask for the rate of contrast expanding for every rectangle, and the created histogram has multiphasic.

[Claim 6] The record medium which recorded the program for making a computer perform the step which makes small the rate of the rectangle of contrast expanding about the rectangle judged that the step which divides an image into two or more rectangles, the step which creates the lightness histogram of each rectangle, the step which investigates whether the created histogram has multiphasic, the step which asks for the rate of contrast expanding for every rectangle, and the histogram which created have multiphasic and in which computer reading is possible.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to image amendment processing in which contrast amendment is performed.
[0002]
[Description of the Prior Art] Various kinds of image amendment processings are performed to digital image data. Making contrast of each part of an image the optimal is known for amendment of the contrast of an image by the high speed by dividing an image into two or more rectangles, and emphasizing it for every rectangle. In one example of contrast amendment processing of a rectangle unit, an image is first divided into a rectangle. Next, it asks for the rate of contrast expanding for every rectangle. It asks for the rate of contrast expanding from the form of a histogram. For example, the rate of expanding is calculated so that a histogram may be elongated to the limit of a dynamic range. It asks for the rate of contrast expanding about all rectangles. Next, each pixel of an image is changed at the rate of expanding of the rectangle in which a pixel is contained. In order to maintain the continuity of lightness with an adjacent rectangle, a lightness value is calculated at the rate of contrast expanding of the rectangle which adjoins

each other for every rectangle, and the lightness value after conversion is calculated by linear interpolation.

[0003]

[Problem(s) to be Solved by the Invention] However, in contrast amendment processing of a rectangle unit, two or more fields where a lightness difference is large may be included in one rectangle. In such a case, there was a problem that contrast might be emphasized beyond the need or lightness change might be reversed between adjacent rectangles by contrast amendment processing. Therefore, in case the contrast of an image is emphasized according to a rectangle, an inversion and a partial thing of lightness change for which contrast stretching is carried out and **** is prevented are desired.

[0004] The purpose of this invention is offering the image processing system which performs image amendment processing which makes contrast the optimal, and the image-processing approach.

[0005]

[Means for Solving the Problem] When the division means which divides an image into two or more rectangles, a histogram creation means create the lightness histogram of each rectangle, a distinction means investigate whether the histogram created by the histogram creation means has multiphasic, and a distinction means judge that the histogram has multiphasic, the 1st image processing system concerning this invention carries out field division of the inside of a rectangle by lightness, and is equipped with a contrast expanding means elongate contrast for every field. The 1st image-processing approach concerning this invention divides an image into two or more rectangles, creates the lightness histogram of each rectangle, investigates whether a histogram has multiphasic for every rectangle, about the rectangle in which the histogram has multiphasic, carries out field division of the inside of a rectangle by lightness, and elongates contrast for every field. About the step which divides an image into two or more rectangles, the step which creates the lightness histogram of each rectangle, the step which investigates whether a histogram has multiphasic for every rectangle, and the rectangle in which the histogram has multiphasic, the record medium which the 1st concerning this invention can computer read carries out field division of the inside of a rectangle by lightness, and records the program for making a computer perform the step which elongates contrast for every field.

[0006] The 2nd image processing system concerning this invention is equipped with the division means which divides an image into two or more rectangles, a histogram creation means create the lightness histogram of each rectangle, a distinction means investigate whether the histogram created by the histogram creation means has multiphasic, a means ask for the rate of contrast expanding for every rectangle, and the means that makes small the rate of contrast expanding of the rectangle about the rectangle judged that the histogram has multiphasic. The 2nd image-processing approach concerning this invention divides an image into two or more rectangles, investigates whether the histogram which created and created the lightness histogram of each rectangle has multiphasic, and makes small the rate of contrast expanding of the rectangle about the rectangle with which the histogram which asked for and created the rate of contrast expanding for every rectangle was judged to have multiphasic. The record medium which the 2nd concerning this invention can computer read records the program for making a computer perform the step which makes small the rate of the rectangle of contrast expanding about the step which divides an image into two or more rectangles, the step which creates the lightness histogram of each rectangle, the step which investigate whether the created histogram has multiphasic, the step which ask for the rate of contrast expanding for every rectangle, and the rectangle which were judged that the histogram which created has multiphasic.

[0007]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to an attached drawing. In addition, in a drawing, the same reference designator shows a same or equivalent thing. The information processor (henceforth a system) of the operation gestalt of this invention is the database system of the image data which adopted the graphical user interface (henceforth GUI). As shown in drawing 1 , this system is equipped with arithmetic and program control (henceforth CPU), and the control unit 1 (computer) which

controls the whole system is constituted as a core. A display 2 performs the display of the various screens for actuation etc. while displaying an image or an alphabetic character. A keyboard 3 and a mouse 4 perform various inputs, directions actuation, etc. Floppy (trademark) disk unit 5b performs the writing and read-out of data to floppy disk 5a which memorizes and keeps data and which is a medium. A hard disk drive unit 6 memorizes and keeps image data, its attribute information, etc. A printer 7 outputs the image based on image data on a form. A scanner 8 reads image data in a sheet-like manuscript. CD-ROM equipment 9b reads image data from CD-ROM9a in which a lot of image data was stored in the predetermined format format. The image data read by a scanner 8 and CD-ROM equipment 9b is inputted into a hard disk drive unit 6. These equipments are connected with the control unit 1 through the interconnection cable, respectively. Moreover, the arrow head shown in drawing shows the data flow in this system. In addition, these equipments may be built in a control unit 1, and may be formed in one.
[0008] Drawing 2 is a block diagram centering on a control device 1. A control device 1 is constituted considering CPU201 as a core, and the data bus 220 connected to CPU201 is minded. Various processing programs ROM203 and the various data to memorize The display of RAM204 to memorize, an image, or an alphabetic character The display-control circuit 205 performed on a display 2, the keyboard control circuit 206 which carries out transfer control of the input from a keyboard, the mouse control circuit 207 which carries out transfer control of the input from a mouse 4, the floppy disk drive unit control circuit 208 which controls floppy disk drive unit 5b, A hard disk drive unit 6 The hard disk control circuit 209 to control, the printer control circuit 210 which controls the output to a printer 7, the scanner control circuit 211 which controls a scanner 8, and the CD-ROM drive control circuit 212 which controls CD-ROM drive 9b are connected, respectively. Moreover, the expansion slot 215 for the clock 202 for generating a reference clock required operating this system being connected, and connecting various add-in boards through a data bus 220 further is connected to CPU201. In addition, a SCSI board may be connected to an expansion slot 215, and floppy disk drive unit 5b, a hard disk drive unit 6, a scanner 8, CD-ROM equipment 9b, etc. may be connected through this SCSI board. In addition, although a scanner 8 and CD-ROM equipment 9b are used as image entry-of-data equipment, other input devices, such as a digital camera, may be used. Furthermore, this hardware circuitry may be made to build in image input devices, such as a digital camera.
[0009] In the image automatic amendment processing in this system, image amendment is made to image data. The amendment processing of contrast and brightness which is the object of this invention is included in an image amendment routine. If an amendment processing initiation instruction is inputted by the user, this routine will be started and image amendment processing will be performed automatically. Although error processing and resolution modification processing in image file radial transfer, image display processing, the GUI processing for remedial operation, and GUI processing are included in image automatic amendment in addition to this, the explanation about these is omitted. In addition, such software used for operation of this invention is supplied with storages, such as a floppy disk and CD-ROM, and it is read into a computer and it is performed. As shown in drawing 3 , this contrast amendment section consists of the image division section 20 which divides an image into a rectangle, the histogram creation section 22 which creates a histogram for every rectangle, and the contrast expanding section 24 which elongates contrast for every rectangle. In addition, although contrast amendment processing is explained as a software program below, it is good also considering the at least 1 section as hardware circuitry.
[0010] Drawing 4 divides an image into two or more rectangles, and shows in graph the situation which took out the one rectangle (part which performed hatching). Area A (bright field) and area B (dark field) are included in this rectangle. Here, Point p is a point on area B.
[0011] Drawing 5 is the lightness histogram of the rectangle shown in drawing 4 . It turns out that it is a histogram with multiphasic. A histogram is a histogram which added the histogram of the area A shown by the dotted line, and area B. The lightness value of Point p is pl.
[0012] Drawing 6 shows the lightness histogram after elongating the contrast of the rectangle of drawing 4 by contrast amendment of the former for a comparison. In this contrast amendment, it

asks for the rate of contrast expanding from the form of a histogram for every rectangle. Next, each pixel of an image is changed at the rate of expanding of the rectangle in which a pixel is contained. Here, a lightness value is calculated at the rate of contrast expanding of the rectangle which adjoins each other for every rectangle, and the lightness value after conversion is calculated by linear interpolation. Thereby, the lightness value after conversion of Point p becomes pl'. However, the histogram (refer to drawing 5) of only area B shows that area B is a field where it is better not to perform superfluous amendment. Area B is an extremely dark field (poor field) where distribution is small, and it is because a noise will be emphasized or it will become in spots, if contrast is emphasized too much. In this example of a comparison, pl' becomes quite high lightness and area B has become contrast overamendment.

[0013] Next, contrast amendment processing of the rectangle unit in the 1st operation gestalt of this invention is explained. Drawing 7 shows the Maine processing flow of the contrast amendment by CPU201 of this operation gestalt. First, an image is divided into a rectangle (S10). Next, it asks for the rate of contrast expanding for every rectangle. First, n showing a rectangle is set to 1 (refer to S12 and drawing 8), and it asks for the rate of contrast expanding about the rectangle (S14). And n is incremented (S16), and if n is not larger than the number of rectangular, return and above-mentioned processing are repeated about a total rectangle to S14. Next, each pixel of an image is changed at the rate of expanding of the rectangle in which a pixel is contained (S18). In order to maintain the continuity of lightness with an adjacent rectangle, a lightness value is calculated at the rate of contrast expanding of the rectangle which adjoins each other for every rectangle, and the lightness value after conversion is calculated by linear interpolation.

[0014] Drawing 8 shows the flow of the processing (drawing 7 , S14) which asks for the rate of contrast expanding. First, it investigates whether a histogram has multiphasic (S40). There are approaches, such as investigating the trough of a histogram, in this way of investigating. In addition, by the approach of processing at a high speed, it investigates whether the inside of a rectangle is divided into the rectangle of further some, and the average of each rectangle is calculated, next this average is compared, and it has multiphasic. When there is a rectangle which has a difference above to some extent, it is judged that it has multiphasic (S42). When it is judged that a histogram has multiphasic, field division of YES) and the rectangle is carried out according to lightness by (S42 (S44). Well-known approaches, such as field dilation, are used for the approach of field division. The pixel the field dilation does not have [pixel] a difference in characteristic quantity compared with surrounding it in the characteristic quantity about each pixel is the approach of carrying out sequential integration noting that it is the same field as a circumference pixel. And it asks for the rate of expanding of a histogram for every field (S46). It asks for the rate of contrast expanding from the form of a histogram. For example, when distribution is large to some extent, it is the scale factor which elongates a histogram to the limit of the dynamic range of each rectangle, and when distribution is quite small, it sets up more smallish so that it may not be emphasized too much. On the other hand, when it is judged that a histogram does not have multiphasic, it asks for NO) by (S42, and it asks for the rate of expanding of a histogram in rectangle (S48).

[0015] Drawing 9 is the lightness histogram of the rectangle after contrast expanding of drawing 5 . The lightness value after conversion of Point p becomes pl''. Although area A elongates a histogram to the limit of a dynamic range, in order that area B may press down the rate of expanding, value pl'' after conversion of the point p included in area B seldom changes, and area B does not become contrast overamendment.

[0016] Next, contrast amendment processing of the rectangle unit in the 2nd operation gestalt of this invention is explained. Since the Maine processing flow in the 2nd operation gestalt is the same as the Maine flow (drawing 7) of the 1st operation gestalt, explanation is omitted. Drawing 10 shows the processing which asks for the rate of contrast expanding in the 2nd operation gestalt. First, it asks for the rate of expanding (S60). It asks for the rate of contrast expanding from the form of a histogram. Next, it investigates whether a histogram has multiphasic (S62). How to investigate is the same as that of the 1st operation gestalt. And when it is judged that it has multiphasic, YES) and the rate of expanding of the contrast searched for S60 are set up more smallish by (S64 [illegible]6).

[0017] Drawing 11 shows the lightness histogram after contrast expanding about the rectangle of drawing 4 . The lightness value after conversion of Point p becomes pl'''. Since the rate of expanding was stopped more smallish, as for emphasis of contrast, A and area B are stopped. Value p''' after conversion of p seldom changes from the value of a basis, and area B does not become contrast overamendment. Since the amount of emphasis of contrast (rate of expanding) is dropped on this operation gestalt as compared with the 1st operation gestalt, without dividing a field, the effectiveness of not emphasizing contrast too much beyond the need can be easily acquired at a high speed.

[0018] Next, the effectiveness of processing of this invention in which the inversion of lightness change is prevented is explained. Conventionally, the inversion of lightness change might break out. However, there is effectiveness which prevents the inversion of lightness change by this invention. This detail is explained below.

[0019] Contrast amendment is explained using drawing 12 and drawing 13 . Conventionally, in contrast amendment of a rectangle unit, the lightness value was calculated at the rate of contrast expanding of the rectangle which adjoins each other for every rectangle, and the approach of calculating the lightness value after conversion by linear interpolation is taken. Therefore, the inversion of lightness change might take place conventionally. Drawing 13 shows the rectangle 81 which performed hatching of drawing 12 . Here, the rates of contrast expanding of the rectangle 81 of drawing 12 and a rectangle 82 are 2.0 and 1.0, respectively. Moreover, the rectangle 81 consists of two fields, A and B, and presupposes that the rates of contrast expanding are 2.0 and 1.0, respectively. Moreover, rectangular die length of one side sets to 2L. 2 point p1 on area B and p2 were taken now, contrast was elongated by the conventional approach, and the pixel value after linear interpolation was calculated. In order to simplify explanation, it calculated with interpolation of only a lengthwise direction.
p1= (2 L*p1+L*p1) / 2L=3 L*p 1/2L after conversion p2={2(L+1) *p2+(L-1) *p2} / 2L after conversion =(3L+1) *p2/2L -- in this conventional example, the direction of p2 becomes large in this way depending on the case at the time of p1>p2.

[0020] Generally, when two or more fields (A, B) where a lightness difference is large exist in a rectangle, the rectangle which adjoins the rectangle is one of A and the area B in many cases. In that case, possibility that lightness will be reversed as mentioned above in a conventional method is high. That is, lightness change may be reversed even if it carries out linear interpolation, since the contrast of area B is elongated in response to expanding of the contrast of area A. On the other hand, with the 1st operation gestalt, for conversion of the points p1 and p2 which exist in area B, since field division is carried out since the histogram about a rectangle 81 is ******, and it elongates in quest of the rate of contrast expanding for every field, lightness change is not reversed. Moreover, in the 2nd operation gestalt, for conversion of the points p1 and p2 which exist in area B, since the rate of contrast expanding is made more smallish in consideration of multiphasic, lightness change is not reversed.

[0021] in addition -- the above-mentioned operation gestalt -- the rate of contrast expanding -- contrast amendment -- carrying out -- **** (variable power of the pixel value is carried out at the rate of expanding) -- it does not restrict to this. For example, also when amending contrast using the conversion curve which shows the relation between an input and an output, application of this invention is possible. That is, what is necessary is just to choose or create the divided conversion curve which was suitable for every field with the 1st operation gestalt. Moreover, what is necessary is just to choose or create the conversion curve which does not emphasize contrast too much with the 2nd operation gestalt, when a histogram is multiphasic.

[0022]

[Effect of the Invention] When performing contrast amendment at a high speed to each part of an image, it becomes without losing emphasizing contrast too much on a partial target beyond the need, and reversing lightness change partially. Moreover, since the amount of emphasis of contrast is dropped without dividing a field, the effectiveness of not emphasizing contrast too much beyond the need can be acquired easily at high speed.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing of a whole concept configuration
[Drawing 2] The block diagram centering on a control device 1
[Drawing 3] The block diagram of a contrast amendment system
[Drawing 4] Drawing which divided the image into the rectangle and took out the one rectangle
[Drawing 5] The lightness histogram of the rectangle of drawing 3
[Drawing 6] The lightness histogram of the rectangle after contrast expanding
[Drawing 7] Maine processing flow chart
[Drawing 8] The flow chart of the processing which asks for the rate of contrast expanding in the 1st operation gestalt
[Drawing 9] The lightness histogram of the rectangle after contrast expanding
[Drawing 10] The flow chart of the processing which asks for the rate of contrast expanding in the 2nd operation gestalt
[Drawing 11] The lightness histogram of the rectangle after contrast expanding
[Drawing 12] Drawing of the image for explaining the example of contrast amendment
[Drawing 13] Drawing of the image of the rectangle for explaining the example of contrast amendment
[Description of Notations]
1 Control Device, 2 Display, 5 Floppy Disk Drive Unit, 6 Hard Disk Drive Unit, 8 Scanner, 96 CD-ROM Equipment, 201 CPU

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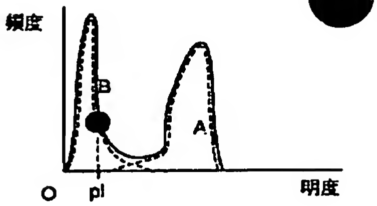
DRAWINGS

[Drawing 5]



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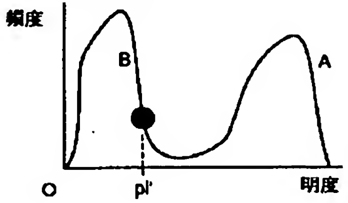

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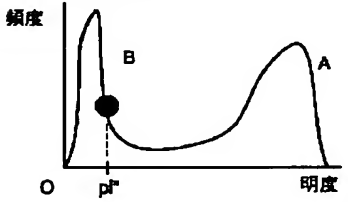

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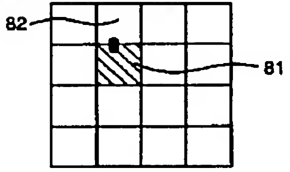

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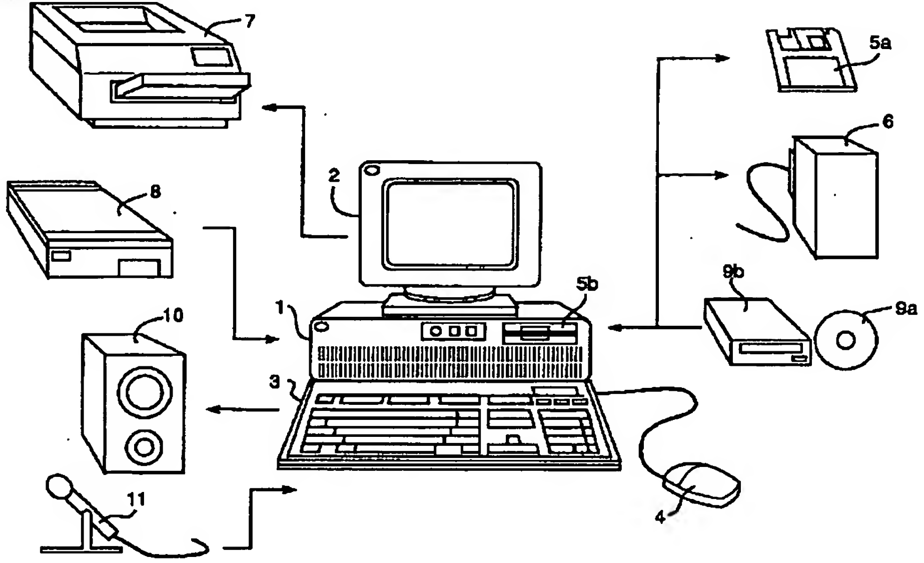
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8
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9a
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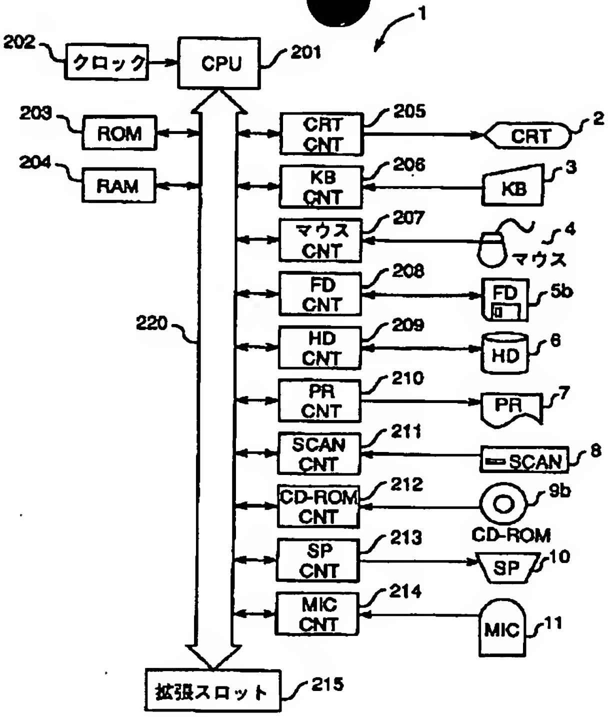
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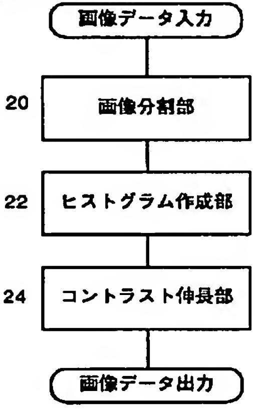
[Drawing 3]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ヒストグラム作成部
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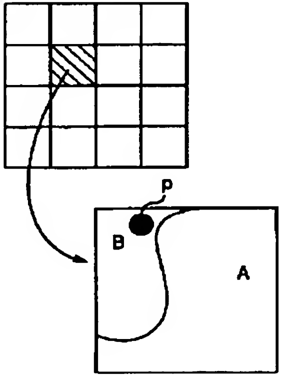
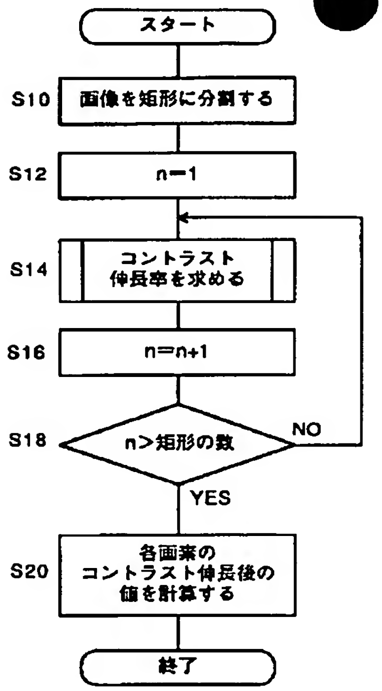
コントラスト伸長部
画像データ出力

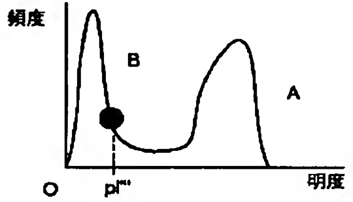
[Drawing 4]



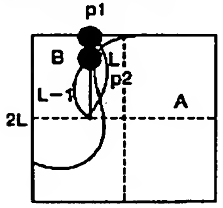
[Drawing 7]


スタート
S10
画像を矩形に分割する
S12
n=1
S14
コントラスト伸長率を求める
S16
n=n+1
S18
n>矩形の数
NO
YES
S20
各画素のコントラスト伸長後の値を計算する
終了

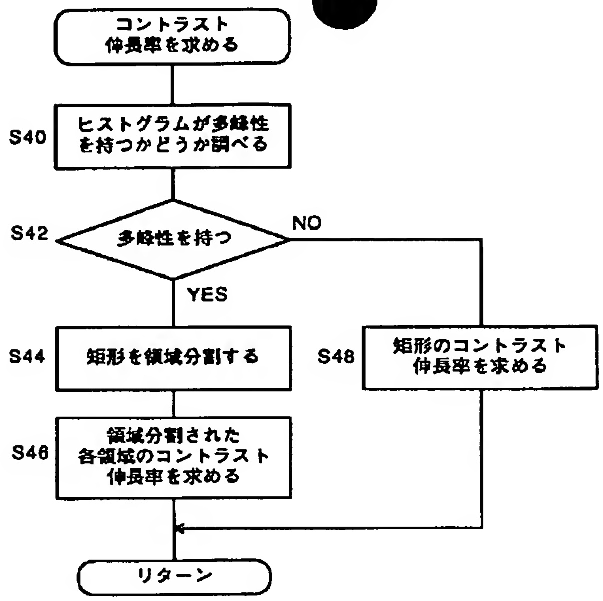
[Drawing 11]



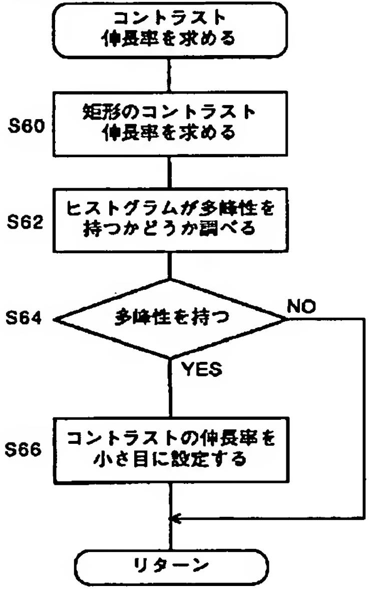
[Drawing 13]


p1
B
L
L-1
p2
A
2L

[Drawing 8]


コントラスト
伸長率を求める
S40
ヒストグラムが多峰性
を持つかどうか調べる
S42
多峰性を持つ
NO
YES
S44
矩形を領域分割する
S48
矩形のコントラスト
伸長率を求める
S46
領域分割された
各領域のコントラスト
伸長率を求める
リターン

[Drawing 10]


コントラスト
伸長率を求める
S60
矩形のコントラスト
伸長率を求める
S62
ヒストグラムが多峰性を
持つかどうか調べる
S64
多峰性を持つ
NO
YES
S66
コントラストの伸長率を
小さ目に設定する
リターン

[Translation done.]